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Helen Grace B. Gonzales, Cognizance Journal of Multidisciplinary Studies, Vol.5, Issue.9, September 2025, pg. 41-47
(An Open Accessible, Multidisciplinary, Fully Refereed and Peer Reviewed Journal)
ISSN: 0976-7797
Impact Factor: 5.183
Index Copernicus Value (ICV) = 92.57

Training Needs Assessment for Mentorship in the National Robotics Competition (NRC) 2025

Helen Grace B. Gonzales

College of Technology & University of Science and Technology of Southern Philippines, Philippines
helengrace.gonzales@ustp.edu.ph

DOI: 10.47760/cognizance.2025.v05i09.002

Abstract: This paper presents a training needs assessment (TNA) undertaken for the Mentorship Program in preparation for the National Robotics Competition (NRC) 2025. Fifteen junior high school students from Cagayan de Oro National High School were surveyed to evaluate robotics-related skills, confidence, and resource access. Results showed low confidence in Sumobot assembly (M = 2.27, SD = 0.88) and scoring system knowledge (M = 2.07, SD = 1.16), while teamwork was rated highest (M = 3.80, SD = 1.01). The overall composite confidence score was 2.59 (SD = 0.85), indicating a low-to-moderate readiness level. Access to resources was uneven: only 40% had Sumobot kits, whereas 80% had Line Tracing robots (p = .035). Reliability analysis confirmed excellent internal consistency of the nine-item confidence scale (Cronbach's α = .94). An independent samples t-test revealed that students with prior competition experience (M = 2.87, SD = 0.85) reported higher confidence than those without (M = 2.33, SD = 0.83), though the difference was not statistically significant, t(13) = -1.25, p = .235. The findings highlight critical training gaps in Sumobot preparation and resource allocation, providing evidence to guide targeted mentorship and capacity-building strategies for NRC readiness.

Keywords: Robotics, Training Needs Assessment, Mentorship, STEM Education, Competitions

I. INTRODUCTION

Robotics competitions provide dynamic opportunities for students to apply theoretical knowledge in practical, hands-on problem-solving environments. In the Philippines, the National Robotics Competition (NRC) has become a platform that develops creativity, teamwork, and technical proficiency in STEM disciplines. Participation in such events requires adequate preparation not only in programming and robot design but also in understanding competition rules, strategies, and collaborative skills.

The University of Science and Technology of Southern Philippines (USTP), through its extension initiatives, launched the Mentorship for NRC 2025 program to support partner schools in Cagayan de Oro City. Specifically, junior high school students from Cagayan de Oro National High School were engaged in this mentorship effort. Recognizing that readiness for robotics competitions depends on both technical competence and resource availability, a Training Needs Assessment (TNA) was carried out to establish baseline data on students' confidence levels and resource access.

This study aims to (1) measure the self-assessed confidence of participants across robotics skills such as Sumobot assembly, Line Tracing programming, sensor calibration, and troubleshooting; (2) identify the extent of access to essential resources, including kits, laptops, and practice spaces; and (3) determine whether prior competition experience is associated with higher confidence levels. The results of this TNA provide evidence-based guidance for tailoring mentorship interventions, addressing resource gaps, and strengthening the preparation of participants for the upcoming NRC 2025.

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II. LITERATURE REVIEW

Robotics education has gained significant momentum in recent years, particularly as nations invest in Science, Technology, Engineering, and Mathematics (STEM) initiatives to prepare students for the demands of the 21st century (Alimisis, 2022). Training in robotics is not only about technical skills but also fosters problem-solving, creativity, and teamwork, which are essential in competitive and professional contexts (Barak & Assal, 2020).

A growing body of evidence shows that robotics competitions enhance student engagement and motivation. For instance, López and Miranda (2021) found that student participation in national robotics tournaments increased confidence in computational thinking and coding skills. Similarly, Bascou and Menekse (2021) reported that robotics-based learning environments provide authentic contexts for collaboration and design thinking, skills directly applicable to competitions like NRC.

In the Philippine setting, limited access to robotics kits and laboratory facilities remains a barrier, especially in public schools (Cañete & Tindowen, 2022). The disparity in access creates uneven opportunities for students to develop technical expertise. Resource constraints are often linked to lower self-efficacy, making targeted mentorship programs critical (Kim et al., 2023).

Moreover, the effectiveness of robotics education is influenced by teacher mentorship and structured training programs. Recent studies emphasize that mentorship not only transfers technical knowledge but also supports the development of adaptive strategies and confidence under competition conditions (Hussain et al., 2022). Training Needs Assessments (TNAs) are valuable in this regard, as they systematically identify gaps in skills, resources, and preparedness, enabling institutions to design interventions that are contextually relevant (Nguyen et al., 2023).

Given this background, the present study contributes to the literature by applying a structured TNA in the Philippine high school robotics competition context, focusing on both **skills** (e.g., programming, assembly, troubleshooting) and **resources** (e.g., kits, laptops, practice spaces). This approach provides a comprehensive view of readiness that can inform evidence-based mentorship and capacity-building strategies.

III. METHODOLOGY

A. Research Design

This study utilized a **descriptive survey design** anchored in the Training Needs Assessment (TNA) framework. TNAs provide structured ways to identify skills, knowledge, and resource gaps in order to inform targeted interventions (Nguyen et al., 2023). The design enabled the collection of both self-reported confidence ratings and resource access data from high school students preparing for robotics competitions.

B. Participants

The participants were **15 junior high school students** drawn from Cagayan de Oro National High School, a partner institution of the University of Science and Technology of Southern Philippines (USTP). Selection was purposive, based on the schools' involvement in robotics programs and readiness to participate in the National Robotics Competition (NRC) 2025.

C. Instruments

Two instruments were administered:

1. **Skills and Confidence Scale**
   - Nine items rated on a 5-point Likert scale (1 = Not Confident, 5 = Very Confident).
   - Items measured competencies in robot assembly, Line Tracing programming, scoring system knowledge, sensor calibration, troubleshooting, competition readiness, and teamwork.
   - Composite scores were calculated as the mean across items.
2. **Resource Access Checklist**
   - Five Yes/No items covering access to 1kg Sumobot kits, Line Tracing robots, laptops with Arduino IDE, practice spaces, and prior competition experience.

D. Data Collection Procedure

Surveys were conducted in September 2025 at the USTP Makerspace during an orientation session with the partner schools. Respondents provided informed consent, and the process followed ethical research protocols for minors in educational contexts (Cañete & Tindowen, 2022).

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E. Data Analysis

Data analysis was conducted using **Jamovi 2.5**, a free and open-source statistical software that promotes reproducibility and accessibility in educational research (Navarro & Foxcroft, 2022). The following analyses were performed:

1. **Descriptive statistics** (mean, standard deviation, min, max) for all nine skill-confidence items and the composite score.
2. **Frequency distributions and binomial tests** for Yes/No resource access items.
3. **Reliability analysis** (Cronbach's α) for the Skills and Confidence Scale.
4. **Independent samples t-test** to compare composite confidence between students with and without prior competition experience, with assumption checks (Shapiro–Wilk, Levene's test). Welch's test or Mann–Whitney U was used if assumptions were violated.

The use of Jamovi allowed for clear visualization, reliability testing, and statistical comparisons in a way that is transparent and replicable for future mentorship assessments.

IV. RESULTS

The data collected from 15 participants were analyzed using Jamovi 2.5, an open-source statistical platform widely used for educational research (Navarro & Foxcroft, 2022). Descriptive statistics revealed variation across robotics competencies. The lowest confidence ratings were in Sumobot scoring rules (M = 2.07, SD = 1.16) and Sumobot assembly (M = 2.27, SD = 0.88). In contrast, the highest confidence was reported for teamwork and collaboration (M = 3.80, SD = 1.01). The overall composite confidence score was 2.59 (SD = 0.85), reflecting a low-to-moderate readiness level.

Resource access analysis showed uneven distribution: only 40% of students had Sumobot kits, while 80% had Line Tracing robots (p = .035). Laptops with Arduino IDE were accessible to 73% of participants, while just over half (53%) had practice spaces. Notably, 47% had prior competition experience.

Reliability testing conducted in Jamovi confirmed excellent internal consistency for the nine-item skills scale (Cronbach's α = .94), supporting its validity for future training evaluations.

An independent samples t-test in Jamovi revealed that students with prior competition experience (M = 2.87, SD = 0.85) reported higher confidence than those without experience (M = 2.33, SD = 0.83). However, the difference was not statistically significant, t(13) = -1.25, p = .235, Cohen's d = -0.65. Assumption checks (Shapiro–Wilk, Levene's test) confirmed appropriateness of the test.

A. Skills and Confidence

Students reported low confidence in **Sumobot assembly** (M = 2.27, SD = 0.88) and **scoring rules** (M = 2.07, SD = 1.16). Confidence in **Line Tracing programming** and **sensor calibration** was moderate (M = 2.53 each). **Teamwork** scored the highest (M = 3.80, SD = 1.01). The composite confidence score was **M = 2.59 (SD = 0.85)**, reflecting low-to-moderate readiness.

These findings are summarized in **Table 1**. The distribution of mean scores across all nine items is further illustrated in **Fig. 1**, where teamwork appears as the highest bar and Sumobot scoring as the lowest.

Table 1. Descriptive Statistics of Robotics Skills and Confidence (N = 15)

Variable	M	SD	Min	Max
Sumobot assembly	2.27	0.88	1	4
Programming (Line Tracing)	2.53	1.13	1	4
Sumobot scoring system	2.07	1.16	1	4
Line Tracing bonus points	2.53	1.46	1	5
Sensor calibration	2.53	1.06	1	4
Troubleshooting under time pressure	2.40	0.74	1	3
Confidence in Sumobot	2.20	0.94	1	4

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Confidence in Line Tracing	2.93	1.16	1	5
Teamwork and collaboration	3.80	1.01	2	5
Composite confidence score	2.59	0.85	1	4.44

Note. Ratings on a 5-point Likert scale (1 = Not confident, 5 = Very confident).

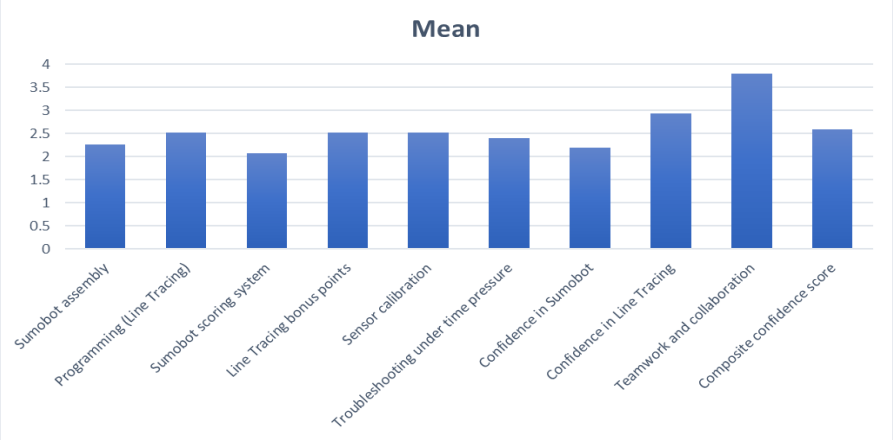

Figure 1. Mean Confidence Levels Across Robotics Skills (N = 15)
A bar chart with each of the nine skills on the x-axis and mean confidence scores (1–5) on the y-axis. Teamwork shows the highest bar (M = 3.80), while Sumobot scoring system is the lowest (M = 2.07).

B. Resource Access

Access to robotics resources was uneven. Only **40% had Sumobot kits**, while **80% had Line Tracing robots** (p = .035). Laptops with Arduino IDE were accessible to 73% of students, and just over half (53%) reported having practice spaces. Less than half (47%) had prior competition experience.

These results are presented in **Table 2** highlighting gaps in Sumobot kit ownership and practice facilities.

Table 2. Resource Access Among Participants (N = 15)

Resource	**Yes (%)**	**No (%)**
Access to 1kg Sumobot kit	40	60
Access to Line Tracing robot	80	20
Laptop with Arduino IDE installed	73	27
Previous competition experience	47	53
Access to practice space	53	47

C. Reliability

The nine-item skills scale showed **excellent reliability (Cronbach's α = .94)**, supporting the use of the composite confidence measure. The results are displayed in **Table 3.**

Table 3. Reliability of Robotics Skills & Confidence Scale

Scale	**No. of Items**	**Cronbach's α**
Robotics Skills & Confidence	9	.94

Note. Cronbach's α ≥ .70 indicates acceptable internal consistency.

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D. Group Comparison

Students with prior competition experience (M = 2.87, SD = 0.85) reported higher overall confidence than those without experience (M = 2.33, SD = 0.83). The difference was not statistically significant, $t(13) = -1.25$, $p = .235$, Cohen's d = -0.65. Assumption checks (normality, homogeneity) were met. The group means are summarized in **Table 4.**

Table 4. Independent Samples T-Test of Composite Confidence by Prior Experience

Group	n	M
No prior experience	8	2.33
With prior experience	7	2.87

The findings highlight key training needs among participants preparing for NRC 2025. The **low confidence in Sumobot assembly and scoring rules** suggests that students require structured, hands-on workshops in these areas. This aligns with earlier studies emphasizing that robotics learning outcomes are strongest when students engage in practical construction and competition-based tasks (Barak & Assal, 2020; Bascou & Menekse, 2021). In contrast, relatively higher confidence in **teamwork** reflects the collaborative culture promoted by robotics programs, consistent with evidence that such competitions foster communication and peer learning (Hussain et al., 2022).

Resource disparities were also evident. The majority of students lacked access to Sumobot kits and practice spaces, mirroring national challenges in robotics education in Philippine schools where equipment availability is uneven (Cañete & Tindowen, 2022). This confirms the need for USTP's mentorship program to supplement equipment access through its Makerspace facilities.

The use of Jamovi facilitated transparent, replicable statistical analysis, from descriptive summaries to reliability testing and group comparisons. The excellent Cronbach's α (.94) confirms that the nine-item confidence scale is a reliable instrument for monitoring progress. Similar reliability results have been reported in STEM education studies using Likert-based scales (Kim et al., 2023).

While students with prior competition experience reported higher overall confidence, the difference was not statistically significant. This suggests that structured mentorship could close the gap for first-time competitors. As Nguyen et al. (2023) note, Training Needs Assessments are valuable tools for identifying such gaps and aligning interventions with participant readiness.

Overall, the findings point toward **targeted mentorship priorities**: (1) strengthen Sumobot-specific training, (2) provide additional access to kits and practice spaces, and (3) use structured coaching to elevate confidence regardless of prior experience. These priorities will not only improve readiness for NRC 2025 but also contribute to long-term STEM capacity building.

V. CONCLUSIONS

This Training Needs Assessment (TNA) provided a clear picture of the baseline competencies and resources of students from Cagayan de Oro National High School as they prepare for the National Robotics Competition (NRC) 2025. Using **Jamovi 2.5** as the primary tool for statistical analysis ensured that results were transparent, replicable, and grounded in robust methods.

The findings revealed **critical gaps in Sumobot-related skills**, particularly in assembly and understanding scoring rules, which were rated with the lowest confidence. In contrast, teamwork emerged as the strongest area, highlighting the collaborative potential of the participants. Resource access was uneven, with **limited availability of Sumobot kits and practice spaces**, while Line Tracing robots and laptops were more accessible. The reliability analysis confirmed the **nine-item Skills and Confidence Scale as a valid and consistent measure** of robotics preparedness.

Although prior competition experience was associated with higher overall confidence, the difference was not statistically significant, suggesting that structured mentorship and training can close the gap for first-time competitors. This underscores the importance of **evidence-based interventions**, where mentorship programs are designed not only to transfer technical knowledge but also to build confidence across all participants.

Overall, the TNA results provide a strong foundation for USTP's mentorship program to **prioritize Sumobot training, expand access to kits and practice facilities, and deliver targeted guidance on programming, troubleshooting, and competition strategies**. By leveraging data-driven insights from Jamovi, the program can

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Impact Factor: 5.183
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ensure that training activities are responsive to the specific needs of learners, ultimately enhancing their readiness and confidence to perform in NRC 2025 and future robotics endeavors.

Based on the results of this Training Needs Assessment (TNA), the following recommendations are proposed to strengthen student readiness for the National Robotics Competition (NRC) 2025 and ensure sustainable mentorship practices:

A. For USTP Mentorship Program

1. **Prioritize Sumobot Training** – Develop intensive workshops focused on assembly, design, and scoring rules, as these areas showed the lowest confidence levels.
2. **Expand Simulation Activities** – Conduct mock battles and troubleshooting exercises to build confidence under competition-like conditions.
3. **Integrate Confidence Monitoring** – Use the validated Skills and Confidence Scale, analyzed through Jamovi, to track student progress before and after mentorship activities.

B. For Partner Schools

1. **Improve Resource Accessibility** – Coordinate with USTP to secure additional Sumobot kits and establish practice spaces within schools.
2. **Encourage Cross-School Collaboration** – Facilitate peer learning sessions between Cagayan de Oro NHS to foster teamwork and mutual support.
3. **Identify and Train Teacher Mentors** – Build teacher capacity so that robotics training is sustained beyond the NRC 2025 cycle.

C. For STEM Education Policy and Extension Work

1. **Leverage Makerspaces** – Institutionalize partnerships with university makerspaces as hubs for robotics training and innovation.
2. **Adopt Data-Driven Approaches** – Encourage the use of open-source platforms such as Jamovi to inform decision-making in training needs assessments.
3. **Promote Equity in Robotics Education** – Address disparities in equipment and technical support to ensure that public school students have equal opportunities to participate in competitions.

ACKNOWLEDGEMENT

The author extends her deepest gratitude to the **University of Science and Technology of Southern Philippines (USTP)** for the support extended to the Mentorship for NRC 2025 project. Special thanks are due to the **faculty and students of Cagayan de Oro National High School–Junior High School** for their active participation in the Training Needs Assessment and for their commitment to robotics education.

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